

National Advisory Committee for Aeronautics

Research Abstracts

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CURRENT NACA REPORTS

NACA Rept. 1121

DIRECT MEASUREMENTS OF SKIN FRICTION.
Satish Dhawan, California Institute of Technology.
1953. ii, 20p. diagrs., photos. (NACA Rept. 1121.
Formerly TN 2567)

A device was developed to measure local skin friction on a flat plate by measuring the force exerted on a very small movable part of the flat plate. The apparatus was applied to measurements in the low-speed range, for both laminar and turbulent boundary layers, and the measured skin-friction coefficients show excellent agreement with Blasius' and Von Karman's results. Measurements were made in high-speed subsonic flow and turbulent-skin-friction coefficients were determined up to a Mach number of about 0.8. A few measurements were also made in supersonic flow.

NACA Rept. 1122

SURVEY OF PORTIONS OF THE CHROMIUM-COBALT-NICKEL-MOLYBDENUM QUATERNARY SYSTEM AT 1200° C. Sheldon Paul Rideout and Paul A. Beck, University of Notre Dame. 1953. ii, 38p. diagrs., photos., 20 tabs. (NACA Rept. 1122. Formerly TN 2683)

A survey was made of portions of the chromium-cobalt-nickel-molybdenum quaternary system at 1200° C by means of microscopic and X-ray diffraction studies. Since the face-centered cubic (alpha) solid solutions form the matrix of almost all practically useful high-temperature alloys, the solid solubility limits of the quaternary alpha phase were determined up to 20 percent molybdenum. The component cobalt-nickel-molybdenum, chromium-cobalt-molybdenum, and chromium-nickel-molybdenum ternary systems were also studied. The survey of these systems was confined to the determination of the boundaries of the face-centered cubic (alpha) solid solutions and of the phases coexisting with alpha at 1200° C.

NACA RM E54E19

EFFECTS OF ADDITIVES ON CORROSION AND MASS TRANSFER IN SODIUM HYDROXIDE - NICKEL SYSTEMS UNDER FREE-CONVECTION CONDITIONS. Americo F. Forestieri. August 1954. 13p. diagrs., photos., 6 tabs. (NACA RM E54E19)

Experiments were carried out under free-convection conditions in sodium hydroxide - "L" nickel systems. Nickel crucibles half full of sodium hydroxide were heated for 24 hours at 1500° F with a temperature difference of 45° F. The effect of additives such as metals, salts, oxides, and nitrides on the extent of corrosion and mass transfer was determined by measurement of the weight change of a specimen in the hot zone, and by metallographic examination of the specimen cross section. Reduction in mass transfer occurred with additives of powdered chromium and aluminum.

NACA RM E54F10

PRELIMINARY INVESTIGATION OF STRESS-RUPTURE AND TENSILE STRENGTH OF THERMENOL, AN IRON-ALUMINUM ALLOY.
Charles A. Gyorgak. August 1954. 11p. diagrs., 3 tabs. (NACA RM E54F10)

An investigation determined the stress-rupture life at 1100° and 1200° F, the room-temperature tensile strength, and the bend ductility of the oxidation-resistant iron-aluminum alloy Thermenol. Stress-rupture strengths for 100-hour life were 19,300 psi at 1200° F and 35,500 psi at 1100° F. The room-temperature tensile strength was 62,050 psi with 3-percent elongation in a 3/4-inch-gage length. Angles of bend to cause failure in the longitudinal and transverse directions ranged from 34° to 56° and were approximately equal.

NACA TN 3155

IMPINGEMENT OF WATER DROPLETS ON NACA 65A004 AIRFOIL AT 8° ANGLE OF ATTACK.
Rinaldo J. Brun, Helen M. Gallagher and Dorothea E. Vogt. July 1954. 27p. diagrs. (NACA TN 3155)

The trajectories of droplets in the air flowing past an NACA 65A004 airfoil at an angle of attack of 8° were determined. The amount of water in droplet form impinging on the airfoil, the area of droplet impingement, and the rate of droplet impingement per unit area on the airfoil surface were calculated from the trajectories and presented to cover a large range of flight and atmospheric conditions. These impingement characteristics are compared briefly with those previously reported for the same airfoil at an angle of attack of 4°.

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NACA TN 3178

CHARACTERISTICS OF TURBULENCE IN A BOUNDARY LAYER WITH ZERO PRESSURE GRADIENT. P. S. Klebanoff, National Bureau of Standards. July 1954. 56p. diagsr. (NACA TN 3178)

The results of an experimental investigation of a turbulent boundary layer with zero pressure gradient are presented. Measurements with the hot-wire anemometer were made of turbulent energy and turbulent shear stress, probability density and flattening factor of u-fluctuation, spectra of turbulent energy and shear stress, and turbulent dissipation. The importance of the region near the wall and the inadequacy of the concept of local isotropy are demonstrated. Attention is given to the energy balance and the intermittent character of the outer region of the boundary layer. Also several interesting features of the spectral distribution of the turbulent motions are discussed.

NACA TN 3209

HIGH-RESOLUTION AUTORADIOGRAPHY. George C. Towe, Henry J. Gomberg and J. W. Freeman, University of Michigan. July 1954. ii, 138p. diagsr., photos., 9 tabs. (NACA TN 3209)

This investigation was made to adapt wet-process autoradiography to metallurgical samples to obtain high resolution of segregated radioactive elements in microstructures. Results are confined to development of the technique, which was perfected to a resolution of less than 10 microns. The radioactive samples included carbon-14 carburized iron and steel, nickel-63 electroplated samples, a powder product containing nickel-63, and tungsten-185 in N-155 alloy.

NACA TN 3269

ADDITIONAL STATIC AND FATIGUE TESTS OF HIGH-STRENGTH ALUMINUM-ALLOY BOLTED JOINTS. E. C. Hartmann, Marshall Holt and I. D. Eaton, Aluminum Company of America. July 1954. 42p. diagsr., photos., 7 tabs. (NACA TN 3269)

Additional static and fatigue tests were made on a few types of joints in 75S-T6, 24S-T4, and 14S-T6 high-strength aluminum-alloy extruded bar in order to supplement the data in NACA Technical Note 2276. Comparisons are made with the results of these earlier tests.

BRITISH REPORTS

N-32203*

Royal Aircraft Establishment (Gt. Brit.)
MECHANICAL PROPERTIES OF SOME D. T. D. COMMERCIAL ALUMINIUM ALLOY SHEET MATERIALS. D. C. Hayward. March 1954. 26p. diagsr., 5 tabs. (RAE Tech. Note Met. 195)

Compressive and tensile tests on aluminum alloy sheet D. T. D. 603, 646, 546, 610, and 687 were made longitudinally and transversely to the rolling direction. Tables of proof-strength values and the tangent-moduli graphs derived are given. Artificial aging was found for small plastic deformation, to raise the stress level of the compressive tangent-moduli curves more than the tensile tangent-moduli curves. The effect of sheet thickness on strength values, investigated for D. T. D. 546 only, showed progressive increase of tensile proof-stress with increase in thickness but under compression, strength varied irregularly with sheet thickness.

N-32204*

Royal Aircraft Establishment (Gt. Brit.)
AIRCRAFT POWER SUPPLY CABLES. D. B. McKenzie. March 1954. 12p., 4 tabs. (RAE Tech. Note EL. 66)

This note deals with the modern types of aircraft cables used for the power supply circuits. It covers the pren, nypren, glasil, glasef and fire types describing their uses and limitations, and also includes a section giving the equivalent United States cables which will enable users to service N. A. T. O. aircraft with either British or American cables.

MISCELLANEOUS

NACA TN 3120

Errata No. 1 on "SPAN LOAD DISTRIBUTIONS RESULTING FROM CONSTANT VERTICAL ACCELERATION FOR THIN SWEEPBACK TAPERED WINGS WITH STREAMWISE TIPS. SUPERSONIC LEADING AND TRAILING EDGES." Isabella J. Cole and Kenneth Margolis. January 1954.

DECLASSIFIED NACA REPORTS

THE FOLLOWING REPORT HAS
BEEN DECLASSIFIED FROM
CONFIDENTIAL, 7/29/54.

RM L52C21

NACA RM A9E05

THE AERODYNAMIC CHARACTERISTICS THROUGHOUT THE SUBSONIC SPEED RANGE OF A THIN, SHARP-EDGED HORIZONTAL TAIL OF ASPECT RATIO 4 EQUIPPED WITH A CONSTANT-CHORD ELEVATOR. Angelo Bandettini and Verlin D. Reed. June 30, 1949. 50p. diagrs., photo. (NACA RM A9E05) (Declassified from Confidential, 7/29/54)

The report presents results of tests at Mach numbers from 0.20 to 0.94 of a thin horizontal tail without sweep having an aspect ratio of 4 and taper ratio of 0.5 and equipped with a constant-chord elevator. The tail profile was a sharp-edged, faired double wedge having a thickness-chord ratio of 0.042. The investigation was made at a constant Reynolds number of 2,000,000. The effect of compressibility on the effectiveness of the elevator in producing lift at small angles of attack and elevator deflections was small at Mach numbers less than 0.60; there was a gradual increase in effectiveness between 0.60 and 0.90 Mach numbers and a slight decrease between Mach numbers of 0.90 and 0.94.

NACA RM A9K18

THE EFFECT OF ASPECT RATIO ON THE SUBSONIC AERODYNAMIC CHARACTERISTICS OF WINGS WITH NACA 65₁-210 SECTIONS. Warren H. Nelson and Albert L. Erickson. February 3, 1950. 31p. diagrs., photos., tab. (NACA RM A9K18) (Declassified from Confidential, 7/29/54)

The lift, drag, and pitching-moment characteristics of four model wings of aspect ratios 1, 2, 4, and 6 are presented. The wings all had NACA 65₁-210 sections, taper ratios of 0.4, and 3° dihedral. The 25-percent-chord lines had no sweep. Data were obtained for a Mach number range of 0.4 to 0.9, and an angle-of-attack range of -4° to 20°. The transition location and its effect on drag are studied.

NACA RM A53101

APPLICATIONS OF AUXILIARY AIR INJECTORS TO SUPERSONIC WIND TUNNELS. Joseph M. Spiegel, Robert U. Hofstetter and Donald M. Kuehn. November 1953. 53p. diagrs., photos. (NACA RM A53101) (Declassified from Confidential, 7/29/54)

The use of an air injector as an auxiliary device for reducing starting and running compression ratios of wind tunnels is discussed. A one-dimensional analysis and experimental data are presented to demonstrate the advantages of the device. A design procedure is included for application of the method to existing or proposed wind tunnels.

NACA RM A53L18

EXPERIMENTAL DETERMINATION OF BOUNDARY-LAYER TRANSITION ON A BODY OF REVOLUTION AT $M = 3.5$. James R. Jedlicka, Max E. Wilkins and Alvin Seiff. March 1954. 56p. diagrs., photos. (NACA RM A53L18) (Declassified from Confidential, 7/29/54)

Boundary-layer-transition tests were made in free flight through still air on a small-scale fin-stabilized body of revolution of fineness ratio 30 at a Mach number of 3.5 and length Reynolds numbers of 12 and 24 million. Three types of surfaces were tested and the transition Reynolds number was found to depend critically on the surface smoothness. Angle of attack was found to influence transition strongly. This effect was correlated in terms of pressure rise along streamlines and led to a prediction of the effect of varying the body shape on sheltered-side transition. In general, the transition points were time dependent, fluctuating in one case over a range of Reynolds numbers from 4 to 20 million. Steady laminar flow was observed to a length Reynolds number of 11 million. Transition due to roughness and adverse pressure gradient occurred even though the tests were within the region of theoretical infinite laminar stability to small disturbances.

NACA RM E50F22

FABRICATION AND PROPERTIES OF HOT-PRESSED MOLYBDENUM DISILICIDE. Roger A. Long. August 24, 1950. 34p. diagrs., photos., tab. (NACA RM E50F22) (Declassified from Confidential, 7/29/54)

Hot-pressed molybdenum disilicide bodies produced by industrial methods and sources were evaluated. The outstanding characteristics reported are an elevated-temperature (2400° F) short-time tensile strength of 41,070 pounds per square inch and a 100-hour rupture stress at 1800° F in excess of 30,000 pounds per square inch, as indicated in a preliminary evaluation. The material evaluated was extremely resistant to air corrosion up to 2850° F and generally brittle at temperatures below 2200° F.

NACA RM E51D27

INSTRUMENTATION FOR RECORDING TRANSIENT PERFORMANCE OF GAS-TURBINE ENGINES AND CONTROL SYSTEMS. Gene J. Delio and Glennon V. Schwent. June 27, 1951. 27p. diagrs., photos. (NACA RM E51D27) (Declassified from Confidential, 7/29/54)

Design features are presented for the instrumentation used in a study of the transient performance of gas-turbine engines and control systems. The dynamic characteristics of the instrumentation are discussed and examples are given of typical data on the acceleration of a controlled and an uncontrolled engine.

NACA RM E51K26

PRESSURE DISTRIBUTION AND AERODYNAMIC COEFFICIENTS ASSOCIATED WITH HEAT ADDITION TO SUPERSONIC AIR STREAM ADJACENT TO TWO-DIMENSIONAL SUPERSONIC WING. I. Irving Pinkel, John S. Serafini and John L. Gregg. February 1952. 33p. diags., tab. (NACA RM E51K26) (Declassified from Confidential, 7/29/54)

The modifications in the pressure distributions and the aerodynamic coefficients associated with additions of heat to the two-dimensional supersonic inviscid flow field adjacent to the lower surface of a 5-percent-thickness symmetrical circular-arc wing are presented in this report. The pressure distributions are obtained by the use of a graphical method which gives the two-dimensional supersonic inviscid flow field obtained with moderate heat addition. The variation is given of the lift-drag ratio and of the aerodynamic coefficients of lift, drag, and moment with free stream Mach number, angle of attack, and parameters defining extent and amount of heat addition. The six graphical solutions used in this study included Mach numbers of 3.0 and 5.0 and angles of attack of 0° and 2° .

NACA RM E52A17

PRELIMINARY INVESTIGATION OF THE HEAT-SHOCK RESISTANT PROPERTIES OF MOLYBDENUM DISILICIDE BLADES UNDER CENTRIFUGAL LOAD. Roger A. Long and John C. Freche. May 1952. 15p. diags., photos., tab. (NACA RM E52A17) (Declassified from Confidential, 7/29/54)

An investigation to determine the heat-shock resistant properties of two molybdenum disilicide turbine blades under centrifugal loads imposed by turbine rotation is presented. Molybdenum disilicide turbine blades fabricated by hot-pressing techniques withstood heat-shock conditions under blade centrifugal stresses up to 5350 pounds per square inch. Additional development is required before the heat-shock resistant properties of molybdenum disilicide are satisfactory for turbine-blade application.

NACA RM E52B06

SOME FACTORS AFFECTING FABRICATION AND HIGH-TEMPERATURE STRENGTH OF MOLYBDENUM DISILICIDE. W. A. Maxwell. April 1952. 25p. diags., photos., 3 tabs. (NACA RM E52B06) (Declassified from Confidential, 7/29/54)

It has been demonstrated that the short-time high-temperature strength of sintered molybdenum disilicide can be greatly improved by carbon addition. Improved long-time deformation properties and decreased high-temperature plasticity accompany the carbon additions. These changes are attributed to partial deoxidation by the carbon. Large-grain, hot-pressed molybdenum disilicide having a low oxygen content was found to have superior long-time properties. Hardness and other properties were found to be variable over a wide range.

NACA RM E52D09

SOME STRESS-RUPTURE AND CREEP PROPERTIES OF MOLYBDENUM DISILICIDE IN THE RANGE 1600° TO 2000° F. W. A. Maxwell. June 1952. 19p. diags., photos., 2 tabs. (NACA RM E52D09) (Declassified from Confidential, 7/29/54)

An investigation of the stress-rupture and creep properties of hot-pressed molybdenum disilicide has produced the following results: 1. The long-time strength of molybdenum disilicide at high temperatures is superior to that of the high-temperature alloys and titanium carbide ceramics. 2. The use of molybdenum disilicide above 1800° F may be limited by the creep rate rather than by the stress-rupture life. 3. A comparatively convenient and satisfactory method for creep and stress-rupture testing to 2000° F has been developed.

NACA RM L9B24a

AN EXPERIMENTAL INVESTIGATION OF A GYRO-ACTUATED ROLL CONTROL SYSTEM INSTALLED IN A SUBSONIC TEST VEHICLE. Jerome M. Teitelbaum and Ernest C. Seaberg. April 20, 1949. 26p. diags., photos., tab. (NACA RM L9B24a) (Declassified from Confidential, 7/29/54)

Contains the results of wind-tunnel and flight tests of a gyro-actuated, roll control system installed in a sweptback four-wing subsonic test vehicle. This control system links the control surface directly to the displacement gyroscope and employs a torque motor to limit gyroscope precession. The linking of the control surfaces in this manner results in an autopilot system which gives a no-lag control response to a model displacement without resorting to velocity or acceleration-sensitive devices.

NACA RM L9F15a

LABORATORY INVESTIGATION OF AN AUTOPILOT UTILIZING A MECHANICAL LINKAGE WITH A DEAD SPOT TO OBTAIN AN EFFECTIVE RATE SIGNAL. Ernest C. Seaberg. August 17, 1949. 29p. diags., photos., tab. (NACA RM L9F15a) (Declassified from Confidential, 7/29/54)

The results of a laboratory investigation of a frontlash autopilot are presented in this analysis. The operation of this autopilot is based on the nonlinear principle of utilizing a dead spot in the servomotor feedback linkage to the gyroscope base reference as a means of obtaining a leading control signal. The investigation consists of oscillating-table tests in order to determine the effect of frontlash on the amplitude and phase responses of the system. Roll-simulator tests were also conducted in order to confirm the possibility of stabilization of pilotless aircraft with this type of automatic pilot, and an attempt to bracket the usable range of this autopilot was made by plotting the degree of stability as a function of the aerodynamic roll parameters.

NACA RM L50B13

INVESTIGATION AT HIGH SUBSONIC SPEEDS OF A 45° SWEEPBACK HORIZONTAL TAIL WITH PLAIN AND HORN-BALANCED CONTROL SURFACES.

Harold S. Johnson and Robert F. Thompson. March 31, 1950. 44p. diags., photo., tab. (NACA RM L50B13) (Declassified from Confidential, 7/29/54)

A wind-tunnel investigation of a horizontal tail surface having 45° of sweepback was made through a speed range to a Mach number of 0.89. The 0.25-chord plain flap was tested with and without a horn balance. A comparison is made with the results of a previous investigation of the same model equipped with a larger horn balance. Presented are lift, drag, pitching-moment, and hinge-moment data and lift and hinge-moment parameters.

NACA RM L50F29

STATIC DIRECTIONAL STABILITY OF A TANDEM-HELICOPTER FUSELAGE. Charles C. Smith, Jr. August 9, 1950. 23p. diags., photo. (NACA RM L50F29) (Declassified from Confidential, 7/29/54)

An investigation has been made to determine the static directional stability of a fuselage typical of tandem helicopters. The model consisted mainly of an elliptical-cross-section body and a rear rotor pylon faired to form a large vertical tail with a very thick airfoil section. The investigation included a study of the effect of various modifications to the vertical tail surface on the directional stability of the model.

NACA RM L50I19

THEORETICAL INVESTIGATION OF A PROPORTIONAL-PLUS-FLICKER AUTOMATIC PILOT. Ernest C. Seaberg. October 19, 1950. 54p. diags., photo., tab. (NACA RM L50I19) (Declassified from Confidential, 7/29/54)

An analysis has been made of the stability of a supersonic canard airframe and a proportional-plus-flicker autopilot. Essentially, this autopilot maintains a zero reference about which the output is proportional to the input and a flicker response overrides this proportional response at a fixed angle of

gimbal displacement on either side of the zero gyroscope reference. The analysis consists of an investigation of the calculated transient responses based on the variation of the autopilot and aerodynamic parameters. The calculations are based on the assumption that the proportional part of the system either contains a zero-phase-lag proportional autopilot or is the actual autopilot frequency response approximated by mathematical transfer function.

NACA RM L50I21

DESCRIPTION AND INVESTIGATION OF A DYNAMIC MODEL OF THE XH-17 TWO-BLADE JET-DRIVEN HELICOPTER. George W. Brooks and Maurice A. Sylvester. March 14, 1951. 49p. diags., photos., 6 tabs. (NACA RM L50I21) (Declassified from Confidential, 7/29/54)

A description of the NACA 1/10-scale dynamic model of the XH-17 two-blade jet-powered helicopter is presented and the investigation of the model flutter and ground-vibrations characteristics reported. At design values, rotor-blade flutter of the classical bending-torsion type was observed at speeds corresponding to full-scale tip speeds near the over-speed limit of 800 feet per second. The flutter speed could be raised by increasing the torsional frequencies of the blades and changing the blade chordwise mass distribution. The type of flutter mode depended on whether the model was externally excited. No unstable ground vibrations could be excited on the model.

NACA RM L51F06

EXPLORATORY INVESTIGATION AT HIGH AND LOW SUBSONIC MACH NUMBERS OF TWO EXPERIMENTAL 6-PERCENT-THICK AIRFOIL SECTIONS DESIGNED TO HAVE HIGH MAXIMUM LIFT COEFFICIENTS. Laurence K. Loftin, Jr. and Albert E. von Doenhoff. December 1951. 48p. diags., photo., 2 tabs. (NACA RM L51F06) (Declassified from Confidential, 7/29/54)

The development of a method for deriving thin airfoil sections to have high values of the low-speed maximum lift coefficient is described and the results of an experimental investigation at high and low subsonic Mach numbers of two new symmetrical airfoils of 6-percent thickness are presented. Maximum lift coefficients of about 1.3 were obtained for the two airfoils at low speeds.



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